Residents' Perceptions of the Great Northern Forest and its Management

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EXECUTIVE SUMMARY

Historically, natural disturbance sustained small- and large-scale patches of various cover types and successional stages throughout the forests of northern New York State, Vermont, New Hampshire, and Maine. These forest conditions varied over time in response to a variety of natural factors (e.g., wildfires, wind events, beaver-initiated flooding) as well as alteration by Native Americans and later European settlers. The practical effect of these patterns was high habitat and biological diversity across the landscape. However, early-successional habitats within the GNF have been decreasing in recent decades.

Given these changes in forest conditions, active forest management is an important tool for sustaining both forest-habitat diversity and wildlife diversity in the GNF. Presumably, limited understanding by the public about the ecological role of forest management has led many of the public to oppose active forest management practices, particularly those involving even-aged or commercial treatments. These societal biases put conservation practitioners in the unenviable position of promoting socially unpopular, yet ecologically necessary, forest management treatments to meet legal and ethical mandates related to the preservation of biological diversity.

The purpose of this study was to develop an understanding of the awareness, beliefs, and attitudes of residents of the GNF related to forest ecosystem management. Some research on these topics has been done in the Midwest and South, but focused on attitudes toward the broader, conceptual components of ecosystem management. One study from the Northeast measured attitudes and values toward management of the Green Mountain National Forest in Vermont. However, no study has examined attitudes toward comprehensive forest management in the region that includes private as well as public lands. Our study findings will provide insights that could be used to develop an education program for residents about the various benefits of forest ecosystem management and the losses in biodiversity that occur when forests are not managed in this manner.

STUDY AREA

The GNF includes approximately 26 million acres, from New York's Adirondack Mountains through northern Vermont and New Hampshire, to western and northern Maine. It is the largest contiguous forest remaining in the eastern U.S., and includes the only transitional northern hardwood to spruce-fir forest in the nation. Most of the forested land within the GNF is privately owned, with about half owned by relatively small non-industrial private forest owners. However, public lands occur throughout the GNF, including the 385,000ac Green Mountain National Forest in Vermont, the 800,00acWhite Mountain National Forest in New Hampshire and Maine, and the Adirondack Park in northern New York State (2.5 million ac of public land).

Within the varied topography of the GNF occur about 400 species of birds, 55 species of mammals, 11 species of reptiles, and 19 species of amphibians. Approximately one million people reside permanently within the GNF, and about 70 million people live within an eight-hour's drive. Tourism, recreation, and the wood products industry are key components of the region's economy. However, many local-based, wood-products industries have been negatively

affected by several important changes occurring in the area since the early 1980s, including (1) sale of several large parcels of land to developers by timber companies, (2) forest fragmentation, changed wildlife habitats, and strained soil, water, and recreation resources due to rapid development, and (3) unsustainable forest practices (e.g., high-grading), particularly on smaller, privately-owned parcels.

METHODS

We conducted a mail survey of 5,000 randomly selected households to assess public attitudes toward early- and late-successional forest stages and the concept of active management to sustain early-successional stages. The sample was stratified into rural and non-rural towns within GNF counties within the four states: New York, Vermont, New Hampshire, and Maine. Each of these eight substrata contained a sample of 625 households. We implemented the survey on 18 April 2005 following a standard four-wave procedure. To ensure respondents shared the same understanding of the GNF, we provided key definitions (i.e., Northern Forest, early-successional, late-successional) in the mail questionnaire and as a verbal pre-cursor in a telephone follow-up with 100 non-respondents to the mail survey who we contacted between 10 and 30 July 2005 to assess possible nonresponse bias. All data were analyzed using SPSS-X, version 14.0, and we used $p = 0.05$ as the significance threshold for all analyses.

RESULTS

Response rates and similarities between respondents and non-respondents

- We received 1,109 useable responses out of 4,308 deliverable questionnaires (25.7% response rate).

- Non-respondents were slightly more positive toward use of timber management to sustain early-successional stages, compared to respondents. However, the attitudinal difference between non-respondents and respondents was very slight, with both indicating a positive attitude. Second, there were no differences between non-respondents and respondents for attitude toward early-successional stage, attitude toward late-successional stages, or objective ecological knowledge. Therefore, **we did not adjust the data for any non-response bias**.

- Further, we found no evidence of response bias due to differential responses by strata or by gender. Indeed, social and demographic variables revealed that respondents reflected a broad cross-section of the public in terms of range of ages, gender, population size of area where they reside, and education level. Further, just over one-third of respondents (38.9%) owned >1 acre of forested land (mean = 91.2 acres). Only 2% leased forested land, but the parcels were large (mean = 914.1 acres).

Attitudes

- Respondents had positive attitudes toward both early- and late-successional stages of the GNF, although their attitudes toward late stages were even more positive than toward

early stages. Overall, 51% of respondents had the same attitude toward both stages, 37% had a more positive attitude toward late-successional stages, and 12% were more positive toward early stages. We found no differences between rural and non-rural respondents for either stage. Further, both rural and non-rural residents had a positive attitude toward use of timber management to sustain early-successional stages, and non-rural residents were even more positive than rural residents toward use of timber management.

Cognitive Beliefs

- Respondents experienced a variety of tangible and intangible benefits from the GNF. In general, more respondents experienced intangible benefits (e.g., viewing scenery, observing animals and plants, spiritual renewal) compared to tangible benefits (e.g., hunting, sale of timber or firewood for income). We found no state-specific differences in benefits experienced between rural residents, and none for non-rural residents.

- Ecological knowledge about successional stages and their characteristics in the GNF was low; rural residents averaged 3.0 correct responses out of six questions, and non-rural residents averaged 2.8 correct. A majority of respondents knew that the natural state of the GNF contains a diversity of successional stages. However, we uncovered a misperception that maturing forests with little early-successional habitat have more overall diversity compared to those containing early-successional stages. We also identified the misperception by at least one-quarter of respondents that maturing forests with little early-successional habitat is closer to a natural state for the GNF than a forest with a mix of successional stages.

- Respondents associated a variety of meanings with early-successional stages of the GNF, including instrumental (both ecological and economic), aesthetic beauty, and cultural use of the forest. Meanings were similar for rural and non-rural residents. Ecological instrumental meanings of early-successional stages seemed to be the most tangible, commonly-held, and emotionally important of the meanings we examined, whereas items reflecting economic instrumental meanings had low to moderate indices for these characteristics. Aesthetic – individual expressive meanings had low to moderate tangibility, low commonality (except for commonly held aesthetic beauty), and moderate emotionality. Cultural – social expressive meanings had low to moderate tangibility, commonality, and emotionality.

Affective Beliefs

- Rural and non-rural respondents expressed remarkably similar feelings, with both groups expressing generally positive feelings toward both early- and late-successional stages. However, both groups had even more positive feelings toward late-successional stages compared to early-successional stages.

- Using factor analysis, we identified four underlying components to respondents' feelings. These four components were similar for both early- and late-successional stages of the GNF. A utility component identified positive feelings of usefulness and value (e.g.,

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useful, valuable, good, happy). A healthfulness component expressed positive feelings about feeling healthy and vibrant (e.g., healthy, bright, clean, fragrant). A fear and loathing component indicated negative feelings of fear and perhaps aloneness with both successional stages (e.g., scared, empty, disgusted, tense, or agitated). A spiritual or non-spiritual component reflected feelings at opposite ends of a sacred/mundane continuum, with sacred, fragrant, and relaxed being associated with late-successional stages and mundane and bored with early-successional stages.

Forest Values-orientation Scale

- Factor analysis revealed six value-orientations. An anti-ecologistic orientation reflected limited interest in ecology and scientific understanding of the GNF. A humanistic orientation identified strong, positive emotions, and even love for the forest. A utilitarian orientation reflected that respondents valued use of the GNF to meet practical human needs. A negativistic orientation identified a dislike or even fearfulness of some aspects of the GNF. An anti-management component reflected that some respondents believe it is wrong to use clear-cutting as a way of renewing the forest and because they like to see taller rather than shorter trees in the forest. Finally, an aesthetic orientation revealed that respondents were attracted to the natural beauty of the GNF.

DISCUSSION AND CONCLUSIONS

GNF residents seem to have more positive attitudes towards use of timber management to sustain early-successional stages of forest than does the American public. The positive attitudes toward timber management in our study may have resulted from our explicit linkage of timber management to a favorable purpose – sustaining early-successional stages of the forest – indicating that the context within which timber management is viewed might affect attitudes toward it.

The mostly positive attitudes of rural and non-rural GNF residents about early-successional stages (EARLYATT), late-successional stages (LATEATT), and use of timber management to sustain early stages (MANAGATT) can be explained by the breadth and depth of mostly positive beliefs about them. However, despite experiencing a wide range of benefits (i.e., goods and services) from the GNF, residents seemed unaware that (1) the breadth of benefits is related to diversity of succession-stages within the GNF, and (2) that early-successional stages generally are disappearing. Residents also indicated that they had positive cognitive and affective beliefs about early-successional stages, and expressed both biocentric (ecological) and anthropocentric (utilitarian) meanings with those stages, meanings that had at least moderate commonality, tangibility, and emotionality. The combination of low ecological knowledge, but awareness of the ecological importance of early-successional stages to the overall GNF may explain why we found a supportive EARLYATT but only a mildly supportive MANAGATT.

Any educational programs developed in an effort to improve MANAGATT, in particular, likely would be most successful if they emphasize that sustaining early-successional stages of the GNF is necessary to provide the services and products that people desire (e.g., aesthetic beauty, wildlife observation, etc.). The messages of natural resource professionals may resonate best

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with GNG residents if those messages recognize and communicate about the non-ecosystem-based meanings of early-successional stages by adding anthropocentric justifications about what people want from rural landscapes along with biocentric justifications for sustaining functioning ecosystems.

GNF residents were knowledgeable about some aspects of the GNF, but many either "don't know" or have misperceptions about other aspects, including changes in the amount of early-successional stages that have occurred over the last 50 years, and erroneously believing the resulting forest maturation is increasing the overall plant and animal diversity of the GNF. Another challenge is that many respondents who know about the link between diversity of successional stages and diversity of plant and animal species either think that the amount of early-successional habitat in the GNF is increasing or say they do not know what the trends have been in recent decades. Although we are not certain, it is plausible given these misperceptions that some residents think the benefit-to-cost ratio of actively sustaining early-successional stages is too low. That may be one reason why LATEATT was even more positive than EARLYATT.

One way to overcome misperceptions associated with residents' relatively low ECOKNOW may be to communicate that the benefit-to-cost ratio of actively sustaining early-successional stages is higher than residents perceive it to be. Success may require differentiating between planned, active management to sustain early-successional habitats and the various benefits associated with that stage, and random forest fragmentation from development and "bad management" which undoubtedly diminishes the benefits they currently experience.

The use of ecosystem management terminology (i.e., systems, processes, relationships, spatial and temporal scales) by natural resource professionals decouples the components of the ecosystem from the human condition. In other words, it reflects a biocentric, ecosystem-based meaning of forests and their component parts. One implication of this has been a tendency to want to improve the public's poor knowledge about the ecology of an ecosystem so they will be more receptive to management actions aimed at sustaining that ecosystem.

However, this approach may be misguided in the GNF as we found that residents associated other, more human-centered and even personal meanings with early-successional stages. Further, residents hold these non-ecosystem-based meanings with varying degrees of commonality, tangibility, and emotionality. The messages of natural resource professionals may resonate best with GNG residents if those messages recognize and communicate about the non-ecosystem-based meanings of early-successional stages by adding anthropocentric justifications about what people want from rural landscapes along with biocentric justifications for sustaining functioning ecosystems.

We found remarkable consistency between rural and non-rural respondents (and among states) for the various kinds of beliefs and attitudes we assessed, unlike rural-urban differences reported in other studies. One reason for this consistency might be the greater specificity with which we framed our questions, compared to the broader, more nebulous ecosystem management terms used in other studies. We framed our questions in terms of clearly defined successional stages of the GNF. Then we assessed beliefs and attitudes in term of how those stages fit into the

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broader ecosystem and the important aspects of ecosystem management: (1) managing for a broad range of products and services, (2) large geographic scales, and (3) long temporal scales.

Finally, our discovery of an anti-ecologistic value-orientation reinforces our other conclusions that messages about the ecological importance of different successional stages and the ecological importance of sustaining early stages may not resonate well with many GNF residents. Instead, the messages that are most likely to resonate are those highlighting a combination of utilitarian and amenity values. Residents of the GNF seem to hold dear the practical utility of the forest as well as its substantial aesthetic beauty. They know it is important ecologically and associate instrumental ecological meaning with it, even if their specific ecological knowledge is relatively low. Residents seem to appreciate the economic products from the forest, and associate cultural meaning especially with early-successional stages.

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Key words: attitudes toward timber management, affective beliefs, cognitive beliefs, early-successional forest, Great Northern Forest, late-successional forest, timber management, forest value-orientation scale

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INTRODUCTION

Managing forested ecosystems in a sustainable manner to meet societal needs and interests is a challenging task. Natural resource managers in the Northeast and elsewhere have been relying since the mid 1990s on the concept of ecosystem management to guide their actions (e.g., Egan et al. 1999, Twarkins et al. 2001). Ecosystem management "…integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term" (Grumbine 1994:31) This approach to forest management focuses on the entire forest ecosystem as a single living entity while recognizing its diverse component parts, including forest stands in different stages of succession and their corresponding plant and animal assemblages (Lorimer 2001).

Historically, natural disturbance sustained small- and large-scale patches of various cover types and successional stages throughout the Great Northern Forest (GNF [Lorimer 2001]), which stretches from the Adirondack Mountains of northern New York State, through northern Vermont and New Hampshire, to most of western and northern Maine (Figure 1). Over time, these contrasting forest conditions, and consequently, wildlife habitats formed mosaic patterns which varied in response to such factors as climate change, wildfires, wind events, beaver-initiated flooding, insect infestations, and vegetation alteration by aboriginal peoples (Litvaitis et al. 1999). The practical effect of these patterns was to increase vegetation diversity on a landscape scale, which presumably enhanced habitat and biological diversity. However, these early-successional habitats have been decreasing in recent decades with reversion of agricultural land to forest and overall forest maturation occurring throughout the GNF (Lorimer 2001, Costello et al. 2000).

Coincidentally in recent decades, one unintended consequence of important efforts to increase the abundance of old forest on the landscape has been the development among some segments of the public of an unfounded sentiment that younger (i.e., "early") successional stages of forest inherently yield less value to forest ecosystems or attending wildlife assemblages (Kearney 2001). This misconception, if allowed to persist, will only exacerbate ongoing declines of wildlife species and associations utilizing early-successional stages of forest habitats. For example, U.S. Fish & Wildlife Service Breeding Bird Survey (BBS) data for the Northeast document that although 24% of bird species that nest in mature forests are indeed declining, 48% of breeding birds that nest in younger successional stages are declining. Conversely, 38% of birds that nest in mature forests are increasing, while only 19% of birds that nest in young forests are increasing (BBS data: 1966-2000).

Given the recent changes in forest conditions, active forest management is an important tool for sustaining both forest-habitat diversity and wildlife diversity in the GNF. Decisions about the type and extent of active management to use in a local area occur in the context of what is socially acceptable, economically feasible, and ecologically possible (Firey 1960, More et al. 1999). Unfortunately, many in the general public neither seem to understand the ecological role of forest management nor support implementation of active forest management practices, particularly those involving even-aged or commercial treatments (Tarrant et al. 1997). These societal biases put forest managers and conservation practitioners in the unenviable position of promoting socially unpopular, yet ecologically necessary, forest management treatments to meet legal and ethical mandates related to the preservation of biological diversity.

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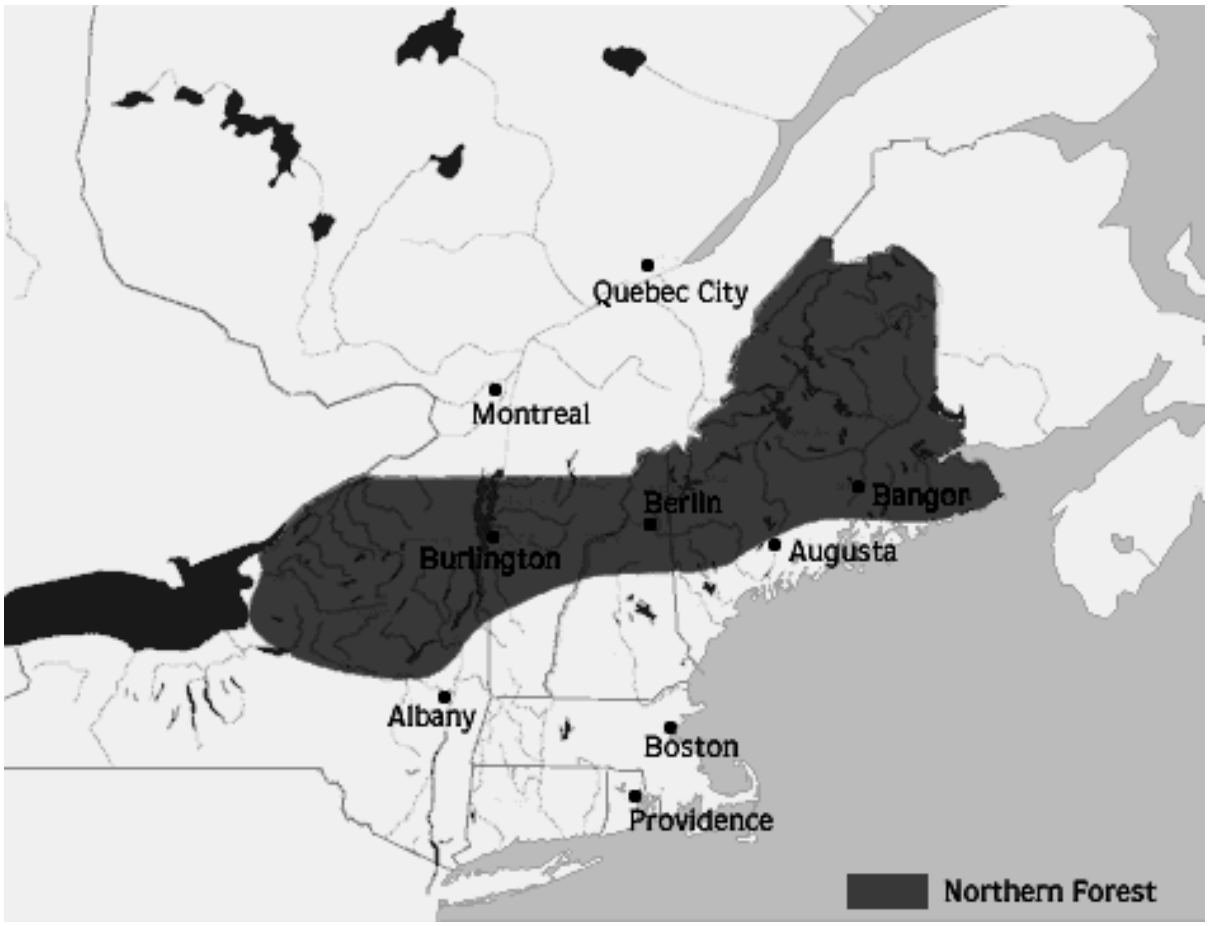

Map credited from http://www.northernforest.org/techmap.htm (accessed 02/16/2006).

Figure 1. Location of the Great Northern Forest occurring from northern New York State, through northern Vermont and northern New Hampshire, to most of northern and eastern Maine, used as the geographic focus for a mail survey of GNF residents in 2005.

The purpose of this study was to develop an understanding of the awareness, beliefs, and attitudes of residents of the GNF related to forest ecosystem management. Some research on these topics has been done in other regions of the U.S. (e.g., Bengston 1993, Brunson et al. 1997, Yarrow and Guynn 1997), but focused on attitudes toward the broader, conceptual components of ecosystem management. Manning et al. (1999) measured attitudes and values toward management of the Green Mountain National Forest in Vermont. However, no study has examined attitudes toward comprehensive forest management in the region that includes private as well as public lands. Our study findings will provide insights that could be used to develop an education program for residents about the various benefits of forest ecosystem management and the losses in biodiversity that occur when forests are not managed in this manner.

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Research Goal and Objectives

Goal: Determine perspectives and perceptions of GNF residents about the desirability, ecological impacts and long-term ramifications of sustainable forest management.

Objective 1) Develop a questionnaire instrument that will facilitate the understanding of a typology of the primary orientations of GNF residents toward forest management. Also develop selected knowledge and attitudinal questions.

Objective 2) Implement this survey to a stratified sample of residents of the Northern Forest in all four states.

STUDY AREA

The GNF includes approximately 26 million acres "stretching from New York's Adirondack Mountains up through the woods of New Hampshire, Vermont, and Maine" (Sierra Club 2006). It is the largest contiguous forest remaining in the eastern U.S., and includes the only transitional northern hardwood to spruce-fir forest in the nation (Fairbanks Museum and Planetarium no date). As of 2001, an estimated 52% of the land area of the GNF was owned by relatively small-scale non-industrial owners, 13% was in forests tied directly to paper or sawlog mills, 20% was in lands managed to provide a steady investment, and the remainder was managed either for a combination of timber and ecological values (5%) or as ecological reserves (10%) (Seville et al. 2001). Associated with these last two categories, public lands are abundant and well-distributed throughout the GNF. The largest parcels are the Green Mountain National Forest in Vermont (385,000 acres; U.S. Forest Service 2006a) and White Mountain National Forest in New Hampshire and Maine (~800,000 acres; U.S. Forest Service 2006b), and the six million acre Adirondack Park in New York State (2.5 million acres of public land and 3.5 million acres of regulated private land).

Rivers and wetlands are abundant in the GNF (Fairbanks Museum and Planetarium no date). It contains >40,000 rivers and streams, including the headwaters of the Hudson, Connecticut, Merrimack, Kennebec, and Penobscot Rivers. The GNF also encompasses almost 2.5 million acres of wetlands, and about 7,700 lakes and ponds.

Ancient mountain ranges provide a diverse topographic landscape (Fairbanks Museum and Planetarium no date). Higher elevations in the GNF occur within the Adirondack Mountains of New York State, northern Green Mountains of Vermont, White Mountains of New Hampshire and Maine, and other high peaks in Maine, including Mount Katahdin. Within the varied topography and diverse habitats of the GNF occur about 400 species of birds, 55 species of mammals, 11 species of reptiles, and 19 species of amphibians (Fairbanks Museum and Planetarium no date).

Approximately one million people reside permanently within the GNF (Sierra Club 2006). Because nearly 70 million people live within an eight-hour's drive of the GNF, tourism and recreation are key components of the region's economy. The wood products industry is the third pillar of the regional economy, and has been important to the region for at least 100 years.

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However, many local-based, wood-products industries have been negatively affected by several important changes occurring in the area since the early 1980s (Fairbanks Museum and Planetarium no date). Several large parcels of land have been sold by timber companies, with subsequent subdivision of those into many smaller parcels. Rapid development has resulted in forest fragmentation, changed wildlife habitats, and strained soil, water, and recreation resources. Further, unsustainable forest practices (e.g., high-grading), particularly on smaller, privately-owned parcels has negatively impacted future timber resources (i.e., devaluing those properties for current owners) and the changing forest tree species composition and stand structure has degraded wildlife habitats.

METHODS

Sampling, Survey Development, and Assessment of Nonresponse Bias

We conducted a mail survey to assess public attitudes toward early- and late-successional forest stages and the concept of active management to sustain early-successional stages. We obtained household sample of 5,000 names, addresses, and telephone numbers from Genesys Sampling (Fort Washington, PA; phone 800-336-7476). Further, the sample was stratified into rural and non-rural towns within GNF counties (i.e., based on definitions by U.S. Census Bureau 2002:7) within the four states: New York, Vermont, New Hampshire, and Maine. Each of these eight substrata contained a sample of 625 households.

The mail survey was implemented on 18 April 2005 following Dilman's (2000) four-wave procedure. We sent instructions with each questionnaire asking that it be completed by the adult with the most recent birthday in the household. To ensure respondents shared the same understanding of the GNF, we provided the following statements in the mail questionnaire and as a verbal pre-cursor to the telephone follow-up in our assessment of possible nonresponse bias:

> **Throughout this questionnaire, the term "Northern Forest" refers to the great swath of forested lands stretching from northern New York through Vermont, New Hampshire, and into Maine. The Northern Forest includes a combination of public lands (State Forest, National Forest) and private lands owned by timber companies, ski areas, hunting clubs, and private citizens.**

In the questionnaire, we also defined successional stages of the GNF as follows:

> **The age of various parts of the Northern Forest varies widely. Some parts of the forest are relatively young (0-20 years old). These parts are called "early successional stages." Other parts contain many trees that are quite old (100+ years). These parts are called "late successional stages."**

To determine whether nonresponse bias existed for attitude and belief questions, we completed telephone interviews with 12-13 nonrespondents to the mail survey from each of the eight substrata. This ensured excellent stratification among the substrata for our grand total of 100 non-respondents to the mail survey. Trained interviewers conducted the non-respondent follow-up between 10 and 30 July 2005.

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We then assessed the existence of nonresponse bias using variables asked in both the mail survey and nonrespondent telephone follow-up. For the continuous variables "how many acres of forested land do you own within the Northern Forest" and "how many acres of forested land do you lease within the Northern Forest?" we used a t-test to compare means. For all other categorical variables (i.e., benefits experienced from the forest, knowledge items, attitude items), we used Chi-square analysis. We conducted these analyses both controlling for gender and without controlling for gender, and both controlling for rural vs. non-rural residence and not controlling for residence. We compared respondents' and non-respondents' data using SPSS-X (Version 14.0), and used P = 0.05 as the significance threshold for all analyses.

Measurement of Human Dimensions Concepts in the Mail Questionnaire

Attitudes: We assessed attitudes toward early-successional stages of the GNF (EARLYATT) using a single question: "Would you say your general attitude toward parts of the forest in "early successional stages" is positive, negative, or neutral? The question had seven possible response categories ranging from 1 (extremely negative) to 4 (neither positive nor negative) to 7 (extremely positive) (Table 1). We assessed attitudes toward late-successional stages of the GNF (LATEATT) using a similar question with appropriate "late-successional" wording.

We assessed attitudes toward use of timber management to sustain early-successional stages of forest habitat (MANAGATT) using 3 questions: (1) Do you like or dislike the prospect of timber management being used to renew "early successional stages" in the Northern Forest; (2) Is the idea of renewing early successional stages of the Northern Forest through timber management a good idea or a bad idea; (3) Do you approve or disapprove of using timber management to renew early successional stages of the Northern Forest. Each question had seven possible response categories ranging from +3 to -3, including 0 for "neither" (Table 1). We averaged responses to the three items to create a single, seven-point index (Azjen and Fishbein 1980) that was highly reliable (Chronbach's a=0.859).

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Table 1. Items used to assess public attitudes toward early- and late-successional stages of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, and attitudes toward use of timber management to sustain early-successional stages, from a mail survey of GNF residents conducted in 2005.

Indices and items used for construction of index	Range of response categories used for index construction	Reliability coefficient
EARLYATT: Attitude toward early-successional stage of forest (single item)	1 to 7	NA
"Would you say your general attitude toward parts of the forest in "early successional stages" is positive, negative, or neutral?		
LATEATT: Attitude toward late-successional stage of forest (single item)	1 to 7	NA
"Would you say your general attitude toward parts of the forest in "late successional stages" is positive, negative, or neutral?		
MANAGATT: Attitude toward use of forest management to sustain early-successional stages (average of following three items, recoded from 1 to 7, to -3 to +3)	-3 to +3	0.859
Do you like or dislike the prospect of timber management being used to renew "early successional stages" in the Northern Forest?	1 to 7	
Is the idea of renewing early successional stages of the Northern Forest through timber management a good idea or a bad idea?	1 to 7	
Do you approve or disapprove of using timber management to renew early successional stages of the Northern Forest?	1 to 7	

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Cognitive Beliefs: We assessed cognitive beliefs (i.e., what people *think)* about the GNF by (1) identifying benefits experienced from the GNF, (2) measuring objective, ecological knowledge about diversity of successional stages, plants, and wildlife in the GNF, and (3) assessing the meanings that people associate specifically with early-successional stages. We identified benefits provided by the GNF by asking respondents to indicate which of 21 possible benefits they have experienced (Table 2). Possible benefits included those we considered tangible (e.g., providing sources of income, location of residence, personal use of firewood) and those we considered intangible (e.g., spiritual renewal, scenic enjoyment).

Table 2. Items used to assess three categories of cognitive beliefs (benefits experienced, ecological knowledge, and meanings) pertaining to early- and late-successional stages of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, from a mail survey of GNF residents conducted in 2005.

Indices and items used for construction of index	Range of response categories used for index construction	Reliability coefficient
BENEFITS:		N/A
Spiritual renewal/solitude	0 (no) 1 (yes)	
Scenic enjoyment	0 (no) 1 (yes)	
Observing trees/flowers	0 (no) 1 (yes)	
Hunting deer or moose	0 (no) 1 (yes)	
Hunting grouse or rabbits	0 (no) 1 (yes)	
Camping	0 (no) 1 (yes)	
Observing wildlife	0 (no) 1 (yes)	
Hiking or cross-country skiing	0 (no) 1 (yes)	
Maple sugar products	0 (no) 1 (yes)	
Locally made furniture	0 (no) 1 (yes)	
Firewood for personal use	0 (no) 1 (yes)	
Horseback riding	0 (no) 1 (yes)	
Grazing or pastureland	0 (no) 1 (yes)	
Selling Christmas Trees	0 (no) 1 (yes)	
I or close family member employed in wood products industry	0 (no) 1 (yes)	
Income from firewood	0 (no) 1 (yes)	
Income from timber	0 (no) 1 (yes)	
Income from hunting lease	0 (no) 1 (yes)	
Personal residence	0 (no) 1 (yes)	
Investment property	0 (no) 1 (yes)	
Vacation property	0 (no) 1 (yes)	

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We measured objective knowledge about the presence and diversity of forest successional stages and associated presence and diversity of wildlife species by asking six "yes, not sure, or no" questions. Two questions pertained specifically to early-successional stages within GNF, and four questions pertained to similarities/differences between early- and late-successional stages and the GNF in general (Table 3). We created a knowledge index (ECOKNOW) by summing the number of correct answers for each respondent.

Table 3. Items used to assess ecological knowledge of residents of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, in a mail survey of GNF residents conducted in 2005.

Indices and items used for construction of index	Correct response	Range of response categories used for index construction
ECOKNOW: Objective knowledge (sum correct responses)		0 to 7
In a natural state, the Northern Forest would be a mix of early successional stages, middle-age stages, and late stages	(Yes)	
The same kinds of plants and animals are found in late successional stages as are found in early successional stages	(No)	
Some kinds of plants and animals live almost exclusively in early successional stages and cannot live in older stages	(Yes)	
The renewal of early successional stages through events like wildfire, ice storms, and logging decreases the overall variety of plants and animals found in the Forest	**(**No)	
Currently, more acreage of the Northern Forest is in early successional stages (0-20 years old) than there was in 1950	(No)	
Early successional stages are disappearing faster than they are being renewed in the Northern Forest	(Yes)	

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Finally, we determined various meanings and the relative tangibility, commonality, and emotionality of those meanings that respondents associated specifically with early-successional stages of GNF by asking them to indicate the degree to which they agreed or disagreed with each of 12 statements. Each statement had five possible response categories ranging from "strongly disagree" (1) to "neither agree nor disagree (3) to "strongly agree" (5). The items were intended to reflect instrumental, aesthetic, individual/expressive, and cultural/symbolic meanings hypothesized by McCool (2001).

Instrumental meanings are those in which early-successional stages of the forest promote a specific behavioral or economic objective; and in which an environmental attribute becomes a "resource." Aesthetic meanings are those involving interpretations of early-successional forest as scenic, beautiful, or peaceful. Cultural/symbolic meanings pertain to human interactions with landscapes at the group level; and where early-successional forests may be associated with some historical or cultural event. Individual/expressive meanings are socially constructed views of early-successional forests, but at individual level. They are related to a sense of identity (e.g., as a birdwatcher or grouse hunter) and reflect statements of "who I/we am/are".

Using the percentage of respondents marking the various response categories for each of the 12 statements, we determined three descriptive characteristics of the four types of meanings (Table 4): relative tangibility, relative commonality, and relative emotionality. We determined relative tangibility by categorizing *post hoc* into thirds the range of the percentage of respondents marking that they neither agreed nor disagreed with the statement (i.e., marked a 3 for the item). We determined relative commonality by examining the percentage of respondents who expressed shared agreement or disagreement about a particular item. Finally, we determined relative emotionality by examining the strength of the beliefs (both positive and negative) about each item.

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Table 4. Items used to assess meanings associated with early-successional stages of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, in a survey of GNF residents conducted in 2005.

Indices and items used for construction of index	Range of response categories used for index construction	Reliability coefficient
Cognitive beliefs about meanings that residents associated specifically with early-successional stages of the Great Northern Forest	Each item measured from 1 (strongly disagree) to 3 (neither agree nor disagree) to 5 (strongly agree)	0.769
are beautiful to see		
contain very few plants or animals	item response reversed prior to factor analysis	
are a place for spiritual renewal		
detract from leaf-viewing tourism	item response reversed prior to factor analysis	
help define the cultural heritage of the area		
are avoided by people who like to identify and watch birds	item response reversed prior to factor analysis	
add to hunting tourism		
result from bad forest management	item response reversed prior to factor analysis	
provide the necessary conditions for certain animals to survive		
detract from the economic vitality of local communities	item response reversed prior to factor analysis	
are a place for me to do activities that are an important part of who I am as a person		
reflect how our cultural heritage is tied to careful use of the forest		

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Table 4. Continued.

Indices and items used for construction of index	Range of respondent percentages used for index construction
For each item used to assess meanings, we determined the following characteristics using a *post-hoc* examination of the range of the percentage of respondents choosing the various response categories.	
Tangibility: percentage of respondents who neither agree nor disagree with the statement	
high	18-28% of respondents neither agree nor disagree
moderate	29-38% of respondents neither agree nor disagree
low	38-48% of respondents neither agree nor disagree
Commonality: percentage of respondents who agree with positive statements or disagree with negative statements	
high	>70% of respondents agree or disagree
moderate	50-70% of respondents agree or disagree
low	<50% of respondents agree or disagree
Emotionality: percentage of respondents who strongly agree and who strongly disagree with statement	
high	12-18% of respondents holding strong beliefs
moderate	6-12% of respondents holding strong beliefs
low	<6% of respondents holding strong beliefs

Affective Beliefs: We assessed affective beliefs (*feelings* people associate with the GNF) for both early-successional forests (0-20 years old; EARLYFEEL) and late-successional forests (>100 years old; LATEFEEL) using identical 16-item semantic differential scales (Snider and Osgood 1969). Semantic differentials have been used extensively to address "…the problem of quantifying highly subjective data, representing difficult-to-verbalize reactions of people to the 'image'" of an object (Mindak 1969). Here, we used early-successional stages as a referent for one scale, and late-successional stages as a referent for the other scale. For both scales, we listed 16 word pairs, adopted from a set of 50 developed and validated by Osgood and Suci (1969:52), to elicit meaningful reactions or judgments from respondents about the referent successional stage (Table 5). Each word pair in the list represented a continuum between polar-opposite terms

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separated by a five-point scale, and the 16-item set reflected a highly reliable index to affective beliefs (Chronbach's alpha > 0.802).

To develop profiles of affective beliefs (i.e., feelings) about the two successional stages, we determined mean values for each word pair for rural residents (for both early- and late-successional stages) and non-rural residents (for early and late stages). We then plotted lines representing the rural-early, rural-late, non-rural-early, and non-rural-late assessments over the semantic differential scale to look for similarities or differences among these four profiles. To further identify any underlying patterns of feelings, we conducted a principal components factor analysis using obliminal rotation (because some of the word pairs were highly correlated).

Table 5. Items used to assess affective beliefs about early- and late-successional stages of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, in a mail survey of GNF residents conducted in 2005.

Polar-opposite word pairs used for construction of affective belief scale							Range of response categories used for index construction	Reliability coefficient
EARLYFEEL							1 – 5 for each item below	.814
LATEFEEL							1 – 5 for each item below	.804
happy	1	2	3	4	5	sad		
useful	1	2	3	4	5	wasteful		
scared	1	2	3	4	5	safe		
good	1	2	3	4	5	bad		
calm	1	2	3	4	5	agitated		
interested	1	2	3	4	5	bored		
sacred	1	2	3	4	5	mundane		
disgusted	1	2	3	4	5	pleasant		
bright	1	2	3	4	5	dark		
relaxed	1	2	3	4	5	tense		
empty	1	2	3	4	5	full		
nice	1	2	3	4	5	awful		
clean	1	2	3	4	5	dirty		
valuable	1	2	3	4	5	worthless		
healthy	1	2	3	4	5	sick		
fragrant	1	2	3	4	5	foul		

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Value-orientations: We developed Forest Value-orientations Scale (FVOS) adapted, in part, from a scale used by Yarrow and Guynn (1997), who had adapted their forest-related items from an earlier, wildlife-related scale developed by Kellert (1976). Yarrow and Guynn identified five categories of forest value-orientations in the Southeast: utilitarian, anti-scientistic, cathedralistic, negativistic, and aesthetic. Our FVOS included 25 total statements (four to six items for each expected value-orientation) intended to confirm/refute the Yarrow and Guynn findings. In our questionnaire, we placed the 25 items randomly in four groups of five to seven items each, between sections measuring other concepts, to minimize respondent fatigue (see Appendix A). For each of the 25 statements, we asked respondents to indicate the degree to which they disagreed (1 = strongly disagree, 2 = disagree), agreed (4 = agree, 5 = strongly agree), or neither agreed nor disagreed (3). Finally, we conducted confirmatory factor analyses to confirm/refute Yarrow's and Guynn's value-orientations among rural and non-rural residents of the GNF.

Social and Demographic Characteristics: We asked respondents to indicate the highest level of education they had obtained: (1) primary school, (2) high school diploma or GED, (3) some college, (4) college degree, (5) post graduate degree, or (6) professional degree. We also asked them to indicate a category that best described the type of area where they lived: (1) on a farm, (2) a rural area, but not a farm, (3) village or city with <25,000 people, (4) city with 25,000-49,999 people, or (5) city with ≥50,000 people. We also asked both groups of residents to indicate their gender and the year in which they were born, which we subtracted from 2004 to calculate AGE. Further, we asked respondents to indicate whether they owned or leased any forested land within GNF, and if so, how many acres they owned or leased.

General Analysis of Data: We analyzed survey data using SPSS-X (Version 14.0), and used P = 0.05 as the significance threshold for all analyses. We used t-tests to compare means between respondents and non-respondents, and between rural and non-rural respondents for continuous variables, and we used Chi-square analyses for categorical variables. We assessed the reliability of all multi-item scales we created (i.e., MANAGATT, ECOKNOW, meanings, EARLYFEEL, LATEFEEL, and FVOS) using Chronbach's alpha coefficient of internal consistency (Chronbach 1951). Finally, we conducted factor analysis (principal components, with varimax rotation except where noted) to help us interpret patterns of responses within ECOKNOW, meanings, EARLYFEEL, LATEFEEL, and FVOS. We determined the number of meaningful underlying components by using a scree test (Cattell 1966) to identify visually the number of components occurring before the "flattening-out" of the scree plot. In all cases, we ensured that the number of components identified by the analysis explained >50% of the variance.

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RESULTS

Survey Response and Non-response Bias

The initial sample of 5,000 GNF households resulted in 4,308 deliverable questionnaires and 1,109 useable returns (25.7% response rate). The number of useable questionnaires returned from each the eight substrata were: New York rural = 145, non-rural = 134; Vermont rural = 180, non-rural = 136; New Hampshire rural = 143, non-rural = 104; and Maine rural = 131, non-rural = 136.

We found no evidence of response bias affecting any of our measures of attitudes or objective, ecological knowledge (Appendix B). Responses weighted to account for differential numbers of respondents by substrata did not differ from un-weighted responses for EARLYATT, LATEATT, MANAGATT, or ECOKNOW. Similarly, responses weighted to account for different numbers of male and female responses did not differ from un-weighted responses for the same four variables.

Non-respondents were more positive toward use of timber management to sustain early-successional stages (MANAGATT), compared to respondents ($p < 0.001$). **We did not adjust the data to account for any possible non-response bias** for three reasons. First, we found no differences between non-respondents and respondents for three of the four important attitudinal and belief variables assessed: EARLYATT ($p = 0.868$), LATEATT ($p = 0.272$), or ECOKNOW ($p = 0.112$). Second, although non-respondents were more positive, compared to respondents, in their attitude toward use of timber management to sustain early-successional stages (MANAGATT), the differences (mean for non-respondents = 1.61, mean for respondents = 1.12) was slight considering the scale ranged from -3 to +3. That is, the direction of the attitude measure was the same, but the strength was slightly different. Third, we found no differences in the proportion female and male non-respondents compared to respondents ($X^2 = 3.350$, $p = 0.067$).

The proportion of non-respondents did not differ from respondents for six benefits experienced from the GNF, including: observing wildlife ($X^2 = 1.258$, $p = 0.262$), hiking or cross-country skiing ($X^2 = 2.887$, $p = 0.089$), camping ($X^2 = 3.119$, $p = 0.077$), personal use of firewood ($X^2 = 3.217$, $p = 0.073$), selling firewood or timber ($X^2 = 0.055$, $p = 0.814$), or themselves/family member employed in forest products industry ($X^2 = 0.270$, $p = 0.603$).

A smaller proportion of non-respondents compared to respondents experienced three benefits from the GNF: observing trees/flowers ($X^2 = 45.659$, $p < 0.001$), scenic enjoyment ($X^2 = 6.413$, $p = 0.011$), and owning/leasing forested land ($X^2 = 10.677$, $p = 0.001$). Non-respondents owning forested land also owned fewer acres (mean = 24.0) compared to respondents (mean = 91.2) ($p = 047$).

A greater proportion of non-respondents compared to respondents experienced four benefits from the GNF: use of maple sugar products ($X^2 = 51.311$, $p < 0.001$), use of locally made wood furniture ($X^2 = 22.912$, $p < 0.001$), hunting of any kind ($X^2 = 9.261$, $p = 0.002$), and spiritual renewal/solitude ($X^2 = 7.724$ $p = 0.005$).

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Characteristics of Respondents

Social and demographic variables revealed that respondents reflected a broad cross-section of the public. The average age of respondents was 53.8 (S.E. = 0.47), ranging from 18 to 93. More than one-half of respondents (58%) were male. Most lived in either a rural, non-farm area (40.7%) or a village/small city of <25,000 people (36.5%). The remainder lived in cities of between 25,000 and 49,999 (11.6%), large cities of >50,000 people (6.3%), or farms (4.9%). More than one-half of respondents had completed some college (27.3%) or had a college degree (28.3%). The remainder was split between those with a high school diploma (21.4%) or less (1.7%), and those with a postgraduate degree (17.0%) or a professional degree (4.3%).

More than one-third of respondents (38.9%) owned >1 acre of forested land (mean = 91.2 acres, S.E. = 31.67 acres), with parcels ranging from 1 to 9,700 acres. Only 2% leased forested land, but lessees leased large parcels (mean = 914.1 acres, S.E. = 355.48), ranging from 1 to 5,800 acres.

Attitudes Toward Early- and Late-successional Stages of the GNF and Toward Use of Timber Management to Sustain Early-Successional Stages

Respondents had positive attitudes toward both early- (mean = 5.34; where 1 = extremely negative and 7 = extremely positive) and late-successional (mean = 5.84) stages of the forest, although their attitudes toward LATEATT were even more positive than toward EARLYATT ($p < 0.001$). Indeed, most residents reported positive attitudes toward both successional stages (67.6% for EARLYATT; 78.1% for LATEATT). However, pair-wise differences in attitudes towards early- and late-successional stages revealed that 51.0% of respondents reported the same attitude toward both stages, 36.7% indicated a more positive attitude toward late-successional stages, and 12.3% reported more positive attitudes toward early-successional stages.

We found no differences between rural and non-rural respondents for either EARLYATT ($p = 0.352$) or LATEATT ($p = 0.400$). Similarly, when we assessed pair-wise differences in attitudes toward early- and late-successional stages, we found no differences ($X^2 = 2.902$, $p = 0.088$) between rural and non-rural respondents with respect to whether they reported more positive attitudes toward early-successional stages (11,8% and 12.8%, respectively), reported more positive attitudes toward late-successional stages (39.0% and 34.0%, respectively), or reported the same attitude for both stages (49.1% and 53.1%, respectively).

Compared to rural respondents (mean = 1.0; where -3 = extremely negative and +3 = extremely positive), non-rural respondents (mean = 1.2) had a more positive attitude toward use of timber management to sustain early-successional stages of the GNF ($p = 0.035$). MANAGATT was a highly reliable scale for both rural respondents (Chronbach's $\alpha = 0.856$) and non-rural residents (Chronbach's $\alpha = 0.863$).

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Cognitive Beliefs About the GNF

Forest Benefits: Respondents experienced a variety of benefits from the GNF (Table 6). In general, a higher percentage experienced intangible benefits (e.g., viewing scenery, spiritual renewal) compared to tangible benefits (e.g., sale of timber or firewood for income). The most substantial difference between rural and non-rural residents was that more rural residents identified the GNF as a location for their personal residence, observing wildlife, hunting, personal use of firewood, and selling timber for income. We examined each of the 21 possible benefits individually, and found no state-to-state or rural-to-non-rural differences in the percentage of respondents experiencing the benefit.

Table 6. Forest-related benefits experienced by residents of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, determined from a mail survey of GNF residents conducted in 2005.

	All respondents experiencing benefit		Non-rural respondents experiencing benefit		Rural respondents experiencing benefit	
Benefit experienced	n	%	n	%	n	%
Enjoying scenery	1004	90.4	465	91.5	539	90.3
Observing trees or flowers	930	84.2	426	83.9	504	84.4
Observing wildlife	809	73.2	341	67.1	468	78.4
Hiking or x-country skiing	606	54.8	263	51.8	343	57.5
Camping	517	46.8	229	45.1	288	48.2
Using maple sugar products	504	45.6	221	43.5	282	47.4
Spiritual renewal/solitude	503	45.5	215	42.3	288	48.2
Personal use of firewood	472	42.7	139	27.4	333	55.8
Location personal residence	360	32.6	72	14.2	288	48.2
Hunting deer or moose	275	24.9	99	19.5	176	29.5
Using locally-made furniture	200	18.1	96	18.9	104	17.4
Hunting grouse or rabbits	167	15.1	62	12.2	105	17.6
Location vacation property	145	13.1	61	12.0	84	14.1
Self/family job in forest products industry	107	9.7	43	8.5	64	10.7
Riding horses	95	8.6	32	6.3	63	10.6
Grazing/using pasture land	85	7.7	19	3.7	66	11.1
Location investment property	67	6.1	19	3.7	48	8.0
Selling timber for income	67	6.1	14	2.8	53	8.9
Selling firewood for income	30	2.7	4	0.8	26	4.4
Selling Christmas trees	26	2.4	8	1.6	18	3.0
Leasing land to hunters	9	0.8	3	0.6	6	1.0

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Objective Ecological Knowledge: Overall, respondents were not particularly knowledgeable about successional stages and their characteristics in the GNF, averaging fewer than three out of six correct answers (ECOKNOW mean = 2.9). Rural respondents were slightly more knowledgeable (mean = 3.0) compared to non-rural respondents (mean = 2.8). The percentage of respondents correctly answering a given question ranged from 15.2% to 83.2% (Table 7). Similar percentages of rural and non-rural respondents answered each question correctly with one exception. More rural (54.8%) than non-rural respondents (48.3%) knew that some kinds of plants and animals live almost exclusively in early-successional stages and cannot live in late-successional stages.

Using the frequency distributions in Table 7, we identified three patterns of responses among the items measuring ECOKNOW. First, the vast majority of all respondents (83.2%) knew that the natural state of the GNF contains a diversity of successional stages. Second, about one-half of respondents (49.7-56.2%) knew that diversity of plant and wildlife species is linked to diversity of successional stages within the GNF, with relatively few respondents answering these items incorrectly, and about one-quarter to one-third indicating "don't know." Third, few respondents (15.2-25.8%) knew about decreases over the last 50 years in the amount of early-successional stages compared to later stages in the GNF, with pluralities of respondents (43.1-50.2%) indicating they "don't know".

Exploring these patterns further using factor analysis (varimax rotation), we identified three underlying components to ECOKNOW, explaining 63.5% of the variance in the relationships (Table 8). Factor 1 grouped items concerning the link between diversity of successional stages and diversity of plants and wildlife. Of the 609 respondents who knew that the same kinds of plants and animals found in late-successional stages are <u>not</u> found typically in early-successional stages, 79.4% also knew that some kinds of plant and wildlife species are found exclusively in early-successional stages and cannot live in older stages.

Factor 2 uncovered a misperception that maturing forests with little early-successional habitat have more overall diversity compared to those where early-successional forests are being renewed through either natural events or timber management. Among the 381 respondents who knew that early-successional stages in the GNF are disappearing faster than they are being replaced, 40.7% incorrectly believed that renewal of early-successional stages <u>decreased</u> overall forest diversity. Another 20.7% of the 381 did not know whether renewal of early stages decreased overall diversity.

Factor 3 suggested a misperception that maturing forests with little early-successional habitat are closer to a natural state for the GNF than forests with a mix of successional stages. Among the relatively few 165 respondents who knew that more acreage of the GNF is <u>not</u> in early-successional forest now compared to 50 years ago, most believed that the natural state of the GNF was <u>not</u> a mix of successional types. Also, of the 545 respondents who marked "don't know" in response to the question about changes in the amount of early-successional stages, 81.8% correctly knew that the natural state of the GNF was a mix of successional stages. Further, of the 375 respondents who incorrectly believed that more of the GNF was in early stages compared to 50 years ago, 88.3% knew that the natural state was a mix of stages.

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Table 7. Number and proportion of respondents who correctly and incorrectly answered questions about successional stages and plant/wildlife diversity within stages of the Great Northern Forest (GNF) occurring from Northern New York State east through northern Maine, determined from a mail survey of GNF residents conducted in 2005.

Knowledge statement	Answer	Correct responses n	%	Don't know responses n	%	Incorrect responses n	%
In a natural state, the Northern Forest would be a mix of early successional stages, middle-age stages, and late stages	(Yes)	906	83.2	124	11.4	59	5.4
The same kinds of plants and animals are found in late successional stages as are found in early successional stages	(No)	610	56.2	310	28.5	166	15.3
Some kinds of plants and animals live almost exclusively in early successional stages and cannot live in older stages	(Yes)	564	51.8	401	36.9	123	11.3
The renewal of early successional stages through events like wildfire, ice storms, and logging decreases the overall variety of plants and animals found in the Forest	(No)	538	49.7	242	22.4	302	27.9
Early successional stages are disappearing faster than they are being renewed in the Northern Forest	(Yes)	388	35.8	468	43.1	229	21.1
Currently, more acreage of the Northern Forest is in early successional stages (0-20 years old) than there was in 1950	(No)	165	15.2	545	50.2	375	34.6

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Table 8. Rotated factor loadings[a] for items used to measure ecological knowledge about the Great Northern Forest (GNF) occurring from Northern New York State east through northern Maine, determined from a mail survey of GNF residents conducted in 2005.

Item	Correct response	Factor loadings on each component: Overall diversity	Diversity in early stages	Changes in proportion of early stage
The same kinds of plants and animals are found in late successional stages as are found in early successional stages	(No)	.835		
Some kinds of plants and animals live almost exclusively in early successional stages and cannot live in older stages	(Yes)	.825		
Early successional stages are disappearing faster than they are being renewed in the Northern Forest	(Yes)		.848	
The renewal of early successional stages through events like wildfire, ice storms, and logging decreases the overall variety of plants and animals found in the Forest	**(**No)		-.712	
Currently, more acreage of the Northern Forest is in early successional stages (0-20 years old) than there was in 1950	(No)			.790
In a natural state, the Northern Forest would be a mix of early successional stages, middle-age stages, and late stages	(Yes)			-.660

[a] Extraction method = principal component analysis. Rotation method = varimax with Kaiser normalization. Rotation converged in four iterations. The three components explain 63.5% of the variance. Only loading >|0.3| are shown.

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Meanings Associated with Early-successional Stages of the GNF: Factor analysis of items used to assess meanings that respondents associated with early-successional stages of the GNF revealed 4 components (Table 9). Two components pertained to instrumental meanings: ecological and economic. Another component identified a combination of aesthetic and individual expressive meanings. The fourth component identified a combination of social and culturally expressive meanings.

Overall, majorities of respondents associated ecological instrumental meanings, aesthetic beauty, and cultural use of the forest with early-successional stages of the GNF (Table 10). Only two of 12 means for items we used to determine meanings were different between rural and non-rural respondents. Rural respondents disagreed more than non-rural respondents that early-successional stages of the GNF contain very few plants or animals ($p = 0.017$), and disagreed more that early-successional stages are avoided by people who like to identify and watch birds ($p = 0.013$).

Ecological instrumental meanings of early-successional stages seemed to be the most tangible, commonly-held, and emotionally important of the meanings we examined, whereas items reflecting economic instrumental meanings had low to moderate indices for these characteristics. Aesthetic – individual expressive meanings had low to moderate tangibility, low commonality (except for commonly held aesthetic beauty), and moderate emotionality. Cultural – social expressive meanings had low to moderate tangibility, commonality, and emotionality.

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Table 9. Rotated factor loadings[a] for items used to measure cognitive beliefs about the meanings respondents associated with early-successional stages (trees ≤20 years old) in the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, determined from a mail survey of GNF residents conducted in 2005.

	Factor loadings on each component			
Statements: "Early-successional stages of the northern forest are…"	Aesthetic/ individual expressive	Instrumental ecological	Instrumental economic	Cultural/ social expressive
beautiful to see	.785			
a place for spiritual renewal	.778			
a place for me to do activities that are an important part of who I am as a person	.701			.348
contain few plants or animals		.786		
provide the necessary conditions for certain animals to survive		.694		
avoided by people who like to watch and identify birds		.684		
detract from the economic vitality of local communities			.767	
result from bad forest management			.752	
detract from leaf-viewing tourism		.440	.619	
add to hunting tourism				.719
reflect how our cultural heritage is tied to careful use of the forest	.395			.580
help define the cultural heritage of the area	.424			.571

[a] Extraction method = principal component analysis. Rotation method = varimax with Kaiser normalization. Rotation converged in seven iterations. The three components explain 60.4% of the variance. Only loading >|0.3| are shown.

Table 10. Percentage of respondents indicating they agreed, disagreed, or neither agreed nor disagreed with statements reflecting cognitive beliefs about meanings they associated with early-successional stages (i.e., with trees 0-20 years old) in the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, showing relative tangibility, commonality, and emotionality of those meanings, from a mail survey of GNF residents conducted in 2005.

Meanings and component statements: "Early-successional stage of the northern forest are…"	Percentage agreeing	Percentage neither agreeing nor disagreeing	Percentage disagreeing	Relative tangibility	Relative commonality	Relative emotionality
Instrumental – ecological						
Provide the necessary conditions for certain animals to survive	75.1	18.7	6.2	high	high	high
Contain very few plants or animals	9.1	27.7	63.2	high	moderate	high
Are avoided by people who like to identify and watch birds	8.3	38.1	53.6	moderate	moderate	moderate
Instrumental – economic						
Detract from the economic vitality of local communities	8.8	35.2	56.1	moderate	moderate	moderate
Detract from leaf-viewing tourism	15.1	36.5	48.4	moderate	low	moderate
Result from bad forest management	14.9	41.5	43.5	low	low	low

Table 10. Continued.

Meanings and component statements: "Early-successional stage of the northern forest are…"	Percentage agreeing	Percentage neither agreeing nor disagreeing	Percentage disagreeing	Relative tangibility	Relative commonality	Relative emotionality
Aesthetic – individual expressive						
Are beautiful to see	70.2	29.7	10.1	moderate	high	moderate
Are a place for spiritual renewal	38.3	48.2	13.5	low	low	moderate
Are a place for me to do activities that are important part of who I am as a person	41.9	44.8	13.3	low	low	moderate
Cultural – social expressive						
Reflect how our cultural heritage is tied to careful use of the forest	54.6	36.4	9.0	moderate	moderate	moderate
Help define the cultural heritage of the area	38.6	45.3	16.1	low	low	low
Add to hunting tourism	42.7	42.2	15.1	low	low	low

Affective Beliefs

Rural and non-rural respondents expressed positive feelings toward both early- and late-successional stages. However, both groups had even more positive feelings toward late-successional stages compared to early-successional stages (Figure 2). The only exception to the overall pattern of feelings was that non-rural respondents believed that late-successional stages made them more scared than safe, and that late-successional stages were scarier than early-successional stages.

Exploratory factor analysis identified four types of affective beliefs for EARLYFEEL and LATEFEEL within both groups of respondents (Odato and Enck in prep). Although the particular items that loaded highly on each type differed slightly among the four comparisons (i.e., rural early, rural late, non-rural early, non-rural late), the named components that reflected the types were consistent, and we present results from the factor analysis for all respondents here for EARLYFEEL and LATEFEEL. We named the four underlying types: (1) utility, (2) healthfulness, (3) fear and loathing, and (4) spiritual or non-spiritual.

The utility component contained seven (EARLYFEEL, Table 11) to eight (LATEFEEL, Table 12) items, all indicating positive aspects of the polar-opposite word pairs (e.g., useful, valuable, good, happy). The healthfulness component contained four to six items also indicating that either successional stage makes respondents feel healthy and vibrant (e.g., healthy, bright, clean, fragrant). The fear and loathing component contained two to three items, which indicated that respondents associated negative feelings of fear and perhaps aloneness with both successional stages (e.g., scared, empty). Additional items that grouped into this component, but which had lower factor loadings, included feelings of being disgusted, tense, or agitated.

Only the sacred-mundane word-pair loaded highly on the spiritual or non-spiritual component, but respondents associated sacred with late-successional stages and mundane with early-successional stages. One to two other items had moderate factor loadings on this component, but higher loadings on other components. Respondents associated fragrant and relaxed with the sacred feeling in LATEFEEL, and they associated bored with the mundane feeling in EARLYFEEL.

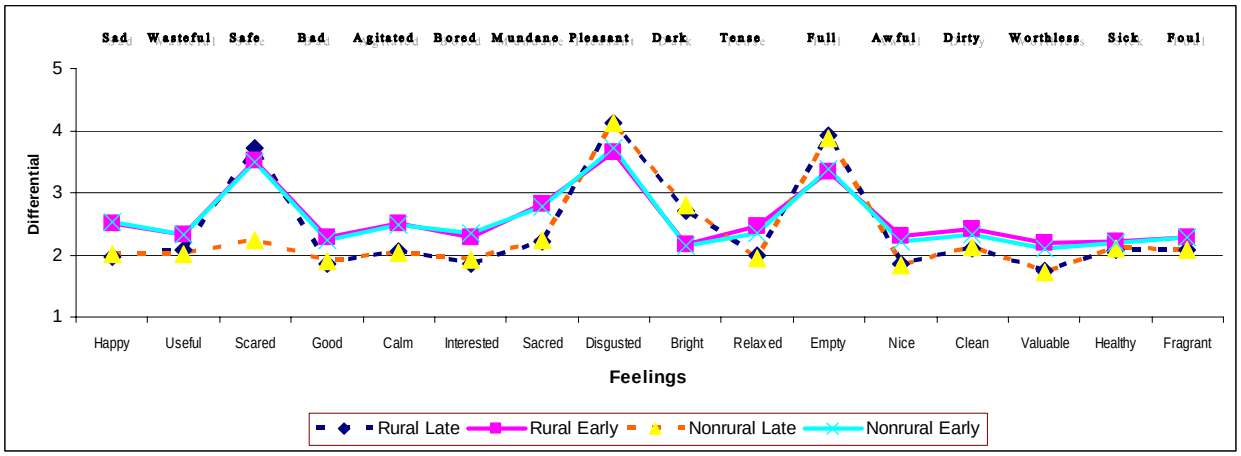

Figure 2. Mean semantic differential scores for 16 polar-opposite word pairs used to elicit affective beliefs (i.e., feelings) toward early- and late-successional forest habitats by rural and non-rural residents of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, determined from a mail survey of GNF residents conducted in 2005

Forest Value-orientation Scale (FVOS)

Because value-orientations reflect deep-seated, hard-to-articulate, and hard-to-measure value systems, we report data for all respondents rather than trying to discern any differences among rural and non-rural respondents. Use of all 25 items in a scale resulted in a reasonably reliable scale (Chronbach's $\alpha = 0.658$). We improved scale reliability (Chronbach's $\alpha = 0.692$) by eliminating 1 item ("my love for nature is one of my strongest feelings"). Although we could have improved the α level by removing up to seven additional items, removing any additional items would have increased the scale variance unacceptably, and would have diminished the amount of variance explained by the underlying components identified. Thus, we used a 24-item forest value-orientation scale (FVOS) to identify respondents' values in the context of the GNF.

Exploratory factor analysis of the 24-item FVOS revealed 6 factors (all with eigenvalues >1.0) that explained 55.3% of the variance (Table 13). We called the first factor an anti-ecologistic component. This component identified a limited public interest in ecology and scientific understanding of the GNF. We called the second factor a humanistic component, which identified strong, positive emotions, and even love for the forest. We called the third factor utilitarian. This factor was associated with use of the GNF to meet practical human needs. We called the fourth factor negativistic, as it identified a dislike or even fearfulness of some aspects of the GNF. We called the fifth factor anti-management because it identified that some of the public believes it is wrong to use clear-cutting as a way of renewing the forest and because they like to see taller rather than shorter trees in the forest. We called the sixth factor an aesthetic component, which was related to the physical beauty and attractiveness of the GNF.

Table 11. Rotated factor loadings[a] for items used in a semantic differential scale to assess affective beliefs of the public toward early-successional stages of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, determined from a mail survey of GNF residents conducted in 2005.

	Components and Factor Loadings			
Polar-opposite word pairs	Utility	Healthfulness	Fear / Loathing	Sacred/Mundane
Useful – Wasteful	.877			
Happy – Sad	.656			
Valuable – Worthless	.629	.341		
Good – Bad	.542	.302		
Disgusted – Pleasant	-.482		.476	
Interested – Bored	.479			-.320
Calm – Agitated	.449		-.396	
Bright – Dark		.965		
Healthy – Sick		.727		
Fragrant – Foul		.724		
Nice – Awful		.548		
Clean – Dirty	.326	.462		
Relaxed – Tense		.442		
Scared – Safe			.938	
Empty – Full			.543	
Sacred – Mundane				-.997

[a] Extraction method = principal component analysis. Rotation method = obliminal. Rotation converged in six iterations. The four components explain 71.0% of the variance. Only loading >|0.3| are shown.

Table 12. Rotated factor loadings[a] for items used in a semantic differential scale to assess affective beliefs of the public toward late-successional stages of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, determined from a mail survey of GNF residents conducted in 2005.

	Components and Factor Loadings			
Polar-opposite word pairs	Utility	Healthfulness	Fear / Loathing	Spiritual / Non-spiritual
Useful – Wasteful	.978			
Interested – Bored	.745			
Valuable – Worthless	.706			
Good – Bad	.675			
Disgusted – Pleasant	-.613		.428	
Happy – Sad	.588			
Nice – Awful	.434			
Calm – Agitated	.392		-.329	
Bright – Dark		.961		
Healthy – Sick		.491		
Fragrant – Foul		.436		.316
Clean – Dirty		.406		
Scared – Safe			.935	
Empty – Full	-.460		.469	
Relaxed – Tense			-.410	.385
Sacred – Mundane				.987

[a] Extraction method = principal component analysis. Rotation method = obliminal. Rotation converged in six iterations. The four components explain 70.9% of the variance. Only loading >|0.3| are shown.

Table 13. Rotated factor loadings[a] for items used to identify value-orientations of residents of the Great Northern Forest (GNF) occurring from northern New York State east through northern Maine, determined from a mail survey of GNF residents conducted in 2005.

	Value-orientation					
Statements	Anti-ecologistic	Humanistic	Utilitarian	Negativistic	Anti-management	Aesthetic
I have little interest in the roles of young trees vs. old trees in the lives of forest animals	.698					
I have little desire to know about the ecology of the Northern Forest	.679	-.334				
I enjoy seeing different types of trees in the forest but have little interest in knowing how various types affect water quality	.664					
My interest in forests is less about any one type of tree and more about how all the types interact	-.546					
I have little desire to see unusual or rare type of trees in the forest	.545					
Plants like Sumac and Red Maple are of little value to nature	.466			.389		
Being surrounded by forest makes makes me feel like a part of nature		.796				
I am a person who really loves the forest		.766				
I like forests because of the sense of solitude and peace I receive there		.731				
I am attracted to the forest because I feel I am close to nature there	-.307	.658				
The idea of loving a forest strikes me as strange	.393	-.501	.374			

[a] Extraction method = principal component analysis. Rotation method = varimax with Kaiser normalization. Rotation converged in 12 iterations. The six components explain 55.3% of the variance. Only loading >|0.3| are shown.

Table 13. Continued.

Statements	Value-orientation					
	Anti-ecologistic	Humanistic	Utilitarian	Negativistic	Anti-management	Aesthetic
I see little wrong with logging the forest if that produces jobs for local residents			.767			
Cutting trees for wood products is ok as long as the tree species is not endangered			.650			
The needs of people are more important than the needs of trees and forests	.347		.535			
Love and emotions should be felt for people, not trees and forests		-.330	.522		.311	
Maintaining our standard of living through logging is more important than protecting a tree species from going extinct	.389		.495			
The best trees in the forest are ones that can be used for a purpose, like lumber, paper or furniture			.332	.651		
Thorny trees and Poison Ivy should be eliminated from forest trails because they area safety hazard	.324			.624		
I like trees the most that have practical value			.384	.591		
I try to avoid places in the forest where trees are dirty or have insects				.568		.440
When I am in the forest, I enjoy seeing taller trees rather than shorter trees and shrubs					.739	
I see little wrong with clear-cutting as a way of renewing forests			.485		-.532	
I enjoy seeing unusual/attractive trees	-.366					.559
If given the choice to see a colorful aspen or a drab oak, I would rather see the aspen						.543

DISCUSSION

Bringing the Broad Concept of Ecosystem Management into a more Practical Experience of Successional Stages within the GNF

Attitudes of PNIF landowners and the general public towards the broad notion of ecosystem management have been relatively well-studied (e.g., Hoover et al. 1995, Tarrant et al. 1995, Yarrow and Guynn 1995, Hodge 1996, Brunson et al. 1997, Rickenbach et al. 1998, Roberts and Parkerr 1998, Stein et al. 1999, Egan et al. 1999, Belin et al. 2005). Generally, these studies have assessed support or opposition to: ecological sensitivity within individual properties, coordinated management decisions across property boundaries, and managing over long temporal scales. Our study focused on the more specific assessment of attitudes toward different age-classes or successional stages within a forest.

We found that residents of the GNF generally have positive attitudes toward both early- (<20 years old) and late-successional (>100 years old) stages of the forest, but in aggregate have more positive attitudes toward late-successional. Pair-wise analyses of attitudes towards early- and late-successional stages by the same individual respondents showed similar attitudes for about one-half of the respondents, more favorable attitudes toward late-successional stages by about 37% of respondents, and more favorable attitudes toward early stages by the remaining 13%. Moreover, we found no differences in attitudes between rural and non-rural respondents.

In nearby Massachusetts, respondents from lower-density towns were reported to have more positive attitudes toward a "landscape-scale perspective" of management that crosses ownership boundaries, compared to respondents from higher-density towns (Belin et al. 2005:33). However, even the attitudes of those rural respondents were less positive in 2005 than they had been in 1998. We cannot compare our attitudes toward successional stages with the broader ecosystem indices of Belin et al., nor can we speculate about any changes in attitudes over time. Nonetheless, the positive nature and consistency of our findings between rural and non-rural respondents would seem to simplify communication and manage efforts among the various residents of the GNF.

One of the most important management efforts with respect to sustaining a diversity of successional stages within the GNF likely will be the use of even-aged management or clear-cutting. Clear-cutting, especially at larger spatial scales on industrial forest lands (e.g., in Maine) has been curtailed in recent years (Gerritt 1997). This does not mean that harvesting has been curtailed throughout the region. Kittredge et al. (2003) reported a substantial degree of selective timber harvesting from both small-scale PNIF lands and larger public lands in northcentral Massachusetts. They surmised that much of that cutting was driven by the price of particular tree species. We have no reason to believe the situation is much different within the GNF.

We found weakly positive attitudes towards use of timber management to sustain early-successional stages of forest. This may be encouraging to managers given the seemingly strong, negative attitudes of the public toward clear-cutting (e.g., Bliss 2000). In our study, "timber management" was framed in the context of sustaining early-successional stages of the forest (a

successional stage viewed favorably), perhaps contributing to our findings of positive attitudes toward timber management. When the purpose of clear-cutting or even-aged timber management has been defined clearly and assessed positively by the public (e.g., to sustain a particular type of tree such as white birch), public attitudes toward active management usually are more favorable (e.g., Kearny 2001). In addition, participation in a greater number of forest-related recreational activities also has been identified as a contributor of more positive attitudes toward clear-cutting (Levine and Langenau 1979).

To what extent does a link exist between the range of benefits experienced by respondents and the notion of ecosystem management to sustain those benefits?

Respondents experienced a wide range of tangible and intangible benefits from the GNF. We found remarkable consistency state-to-state and between rural and non-rural respondents in terms of the proportion of respondents indicating they experienced any of the 21 specific benefits we examined. The wide range of benefits experienced seems consistent with data from studies of private, non-industrial forest (PNIF) owners showing that they manage their properties to provide multiple services or products (Brunson et al. 1997, Roberts and Parker 1998). Hodge (1996, cited in Dedrick et al. 1998) suggested that PNIF owners in Virginia voluntarily had adopted some of the principles of ecosystem management for this very reason – specifically the idea of managing for ecological health over the long-term and for a variety of non-economic amenity values. Two studies of landowners in New England (Rickenbach et al. 1998, Belin et al. 2005) similarly reported that landowners had multiple reasons for owning land, and thus, experienced multiple benefits from it. Further, these landowners also supported the idea of protecting wetlands and rare wildlife species on their own lands as well as throughout the region.

However, most PNIFs with multiple, non-timber objectives tend not to participate in landowner assistance programs sponsored by governmental agencies or university outreach programs (Hoover et al. 1995, Dedrick et al. 1998). These PNIFs may be amenable, however, to participating in "…bottom-up or community driven strategies" (Dedrick et al. 1998:191). If these challenges make it difficult enough to communicate with private landowners and the broader public about how to sustain a breadth of benefits from the GNF, actually sustaining those benefits across the landscape may be particularly challenging.

Application of ecosystem principles on private lands, including managing to provide multiple services and products, is not particularly widespread. Yarrow and Guynn (1995) found that only 19% of survey respondents in nine mid-south states applied ecosystem management on their properties. Although respondents in that study supported many of the elements of the concept of ecosystem management, they were uncertain about whether application of it on private land would (1) erode private property rights, (2) make timber harvesting more acceptable to the public, (3) put ecological concerns ahead of landowners' needs, or (4) incorporate sound forestry science.

To what extent does a link exist between sustainability of benefits and ecological knowledge about successional stages within the GNF?

Our study focused more directly on public perceptions of different successional stages within the GNF, rather than on ecosystem management *per se*. Nonetheless, we determined those perceptions in the context of the vast GNF ecosystem. For example, our knowledge questions included both broad geographic scales and long temporal aspects. They also tied plant and animal diversity to specific successional stages as well as the diversity of those stages across the landscape. Most respondents knew that the natural condition of the GNF would be a mix of successional stages across the landscape. However, relatively few were knowledgeable of the temporal aspects of changes within the forest, particularly the decrease in the amount of early-successional stages occurring over the last 50 years. Only about half were knowledgeable about how plant and animal diversity is linked to diversity of successional stages at larger geographic scales.

Respondents who are knowledgeable about some aspects of the GNF either "don't know" or have misperceptions about other aspects. For example, many of the residents who know about the temporal changes occurring in the amount of early-successional stages (i.e., that they have been decreasing over the last 50 years) erroneously believe the resulting forest maturation is increasing the overall plant and animal diversity of the GNF. Another challenge is that many respondents who know about the link between diversity of successional stages and diversity of plant and animal species either think that the amount of early-successional habitat in the GNF is increasing or say they do not know what the trends have been in recent decades. Although we are not certain, it is plausible given these misperceptions that some residents think the benefit-to-cost ratio of actively sustaining early-successional stages is too low. That may be one reason why public attitudes toward late-successional stages are even more positive than attitudes toward early-successional stages.

To what extent does the public associate ecosystem-based meanings with early-successional stages of the GNF?

Natural resource professionals seem typically to think about components of forests, whether they be plant or animal species, or successional stages, in terms of …"systems, processes, and relationships" within a broader ecosystem (Hammitt et al. 1995:82). This reflects a biocentric, ecosystem-based meaning of forests and their component parts (Stein et al. 1999). One implication of this has been a tendency to want to improve the public's poor knowledge about the ecology of an ecosystem so they will be more receptive to management actions aimed at sustaining that ecosystem (Hammitt et al. 1995, Hoover et al. 1995).

Respondents in our study certainly associated ecological meaning and interconnectedness with early-successional stages of the GNF. However, they also associated economic, individual-expressive, and cultural meaning with younger forests. Further, the public holds these non-ecosystem-based meanings with varying degrees of commonality, tangibility, and emotionality. Educating the public about the need to sustain early-successional stages of the forest using an ecological or even economic argument may be useful, but probably would not be entirely successful. A need exists to also recognize and communicate about the non-ecosystem-based

meanings of early-successional stages. Stein et al. (1999) have argued that persuasive communication efforts are likely to be most successful when anthropocentric justifications about what people want from rural landscapes are added to biocentric justifications for sustaining functioning ecosystems.

It is plausible that one reason why use of timber management to sustain early-successional stages of the GNF might be contentious (despite a weakly positive MANAGATT) is that various residents assign different meanings to early-successional stages. We found that at least some meanings are not widely shared and thus perhaps not well-understood, but have high emotionality associated with them. For example, beliefs about early-successional stages providing opportunities for solitude and individual expression had low commonality indices, but had moderate indices of emotionality.

Thinking vs. Feeling About Early- and Late-Successional Stages

Given the similarities between rural and non-rural residents with respect to cognitive beliefs (i.e., what people think about the forest), we expected similarities in terms of affective beliefs (i.e., what people feel about the forest). Generally, rural and non-rural residents had remarkably similar feelings toward each successional stage despite living their lives in very different physical spaces within the forest. All respondents associated slightly more "extreme feelings" (i.e., higher or lower response choices) with late-successional stages, and slightly more neutral or ambivalent feelings (i.e., mid-range responses) with early-successional stages. Overall, we identified four groups of feelings that respondents associated with both successional stages. Three of these were positive and one negative for late-successional stages, and two were positive, one negative, and one more neutral for early-successional stages.

Osgood and Suci (1969) reported on the use of a larger, 50-item semantic differential scale in a number of studies, and their consistent findings of three groupings of feelings: evaluative, potency, and activity. We purposefully chose a smaller 16-item set of feelings we believed would be more salient in terms of the GNF. This reduced set contained mostly items Osgood and Suci considered to be evaluative given that they found evaluative feelings to explain about 70% of the variance in feelings towards different objects, and a minority of our items pertained to their "activity" category.

For both early- and late-successional stages, we identified two groups of positive feelings that seem to be evaluative in nature. Utility describes feelings such as useful, valuable, good, happy, and nice. Healthfulness describes feelings such as bright, healthy, and clean. Also, for both early- and late-successional stages, we identified a negative group of feelings we called "fear and loathing" that reflected being scared, disgusted, tense, agitated and empty. These kinds of feelings describe a physical or physiological condition of unease in the respondents, and appear to identify the "activity" category of feelings mentioned by Osgood and Succi (1969).

Perhaps the most substantial difference in feelings toward the two successional stages was whether a particular stage made the respondents feel sacred (late) or mundane (early). These findings seem to indicate that respondents associate some level of spirituality with the taller trees in the older stages of the forest, but a more "boring," commonplace feeling with the typically

smaller-size trees of early stages. How these feelings may change temporally remains unknown. As any site or stand matures from early-successional to later stages, perceptions of people who experience it are likely to become more positive (Shelby et al. 2003). However, sustaining early-successional stages across the landscape of the GNF and through time may sustain the feelings of "fear and loathing" and "boring," commonplace feelings.

Forest Value-orientation Scale

Assessing people's values is important for several reasons. Values help shape peoples' interpretations of their world. They underlie and inform people choices and behaviors. Perhaps most important in the context of this study, values are thought to be the fuzzy, hard-to-articulate basic beliefs that inform peoples' attitudes, and ultimately their behaviors (Tarrant et al. 2003). Given the difficulty in measuring values, researchers typically use numerous statements to determine respondents value-orientations, or indices to underlying values.

Some previous studies have measured the importance to the public of certain forest-related values. For example, Tarrant et al. (2003) confirmed a small set of values important to the public – those consistent with management activities on national forests – and determined that greater emphasis was placed on protection and amenity values over products from the forest. Manning et al. (1999) reported that Vermont residents placed highest importance on aesthetic, ecological, and recreational values on the Green Mountain National Forest. The least importance was placed by Vermont residents on economic, spiritual, and intellectual values. Both of these studies assessed the importance or worth of the forest for particular purposes – i.e., they measured what has been referred to as *assigned values* (Rokeach 1973).

We adopted Yarrow's (1998) approach for measuring value-orientations that reflect *held values* (Rokeach 1973), based on Kellert's (1976) development of a scale to assess nine hypothesized wildlife-related values. Held values reflect desirable end states or qualities of life. They also reflect people's basic beliefs about, in this case, the GNF, and their experiences with the forest.

We identified six types of value-orientations. The first, anti-ecologistic, reflected the public's general agreement that they have little interest in the ecological function or little desire for ecological knowledge about the forest and its component parts. A humanistic value-orientation identified general agreement with statements giving human emotions (e.g., love) to the forest, and feeling connected to and surrounded by the forest. Conversely, a utilitarian value-orientation reflected that respondents value the forest for products it provides and its economic contributions to individual and community well-being. People holding this value-orientation also believe it is inappropriate to give the forest human-like characteristics or emotions.

The fourth value-orientation we identified was negativistic, reflecting that some parts of the forest were undesirable, dirty, injurious, and generally were to be avoided. On the other hand, we identified an aesthetic value-orientation that appreciated the beauty, attractiveness, and uniqueness of the forest. Finally, an anti-management orientation reflected a disagreement about the appropriateness of using clear-cutting to renew the forest, apparently because of valuing taller, older trees much more than smaller, younger trees.

Our findings generally were consistent with those of Yarrow (1998), who identified five value-orientations: utilitarian, anti-scientistic, cathedralistic, negativistic, and aesthetic management. Her utilitarian, negativistic, and aesthetic management orientations were virtually identical to ones we identified. Her anti-scientistic orientation reflected a lack of interest in the scientific study and ecological functioning of forests, making it similar to our anti-ecologistic orientation. Yarrow's Cathedralistic orientation included holding values of spiritual renewal and solitude as well as giving human feelings of love and reflection to the forest, somewhat similar to our humanistic orientation.

CONCLUSIONS

The mostly positive attitudes of GNF residents about early-successional stages (EARLYATT), late-successional stages (LATEATT), and use of timber management to sustain early stages (MANAGATT) were explained well by the breadth and depth of mostly positive beliefs about them. However, despite experiencing a wide range of benefits (i.e., goods and services) from the GNF, residents seemed unaware that (1) the breadth of benefits is related to diversity of succession-stages within the GNF, and (2) that early-successional stages generally are disappearing. Residents also indicated that they had positive cognitive and affective beliefs about early-successional stages, and expressed both biocentric (ecological) and anthropocentric (utilitarian) meanings with those stages, meanings that had at least moderate commonality, tangibility, and emotionality. The combination of low ecological knowledge, but awareness of the ecological importance of early-successional stages to the overall GNF may explain why we found a supportive EARLYATT but only a mildly supportive MANAGATT.

Any educational programs developed in an effort to improve MANAGATT, in particular, should be based on the tenets of social marketing, which Tyson et al. (1998:34) defined as "…the application of research-based marketing concepts – behavior theory, audience segmentation, message design – to promote socially beneficial behavior." Programs likely would be most successful if they emphasize that sustaining early-successional stages of the GNF is necessary to provide the services and products that people desire (e.g., aesthetic beauty, wildlife observation, etc.). The messages of natural resource professionals may resonate best with GNG residents if those messages recognize and communicate about the non-ecosystem-based meanings of early-successional stages by adding anthropocentric justifications about what people want from rural landscapes along with biocentric justifications for sustaining functioning ecosystems.

The most successful efforts might be those which attempt to overcome misperceptions associated with residents' relatively low ECOKNOW as a way of communicating that the benefit-to-cost ratio of actively sustaining early-successional stages is higher than they perceive it to be. Differentiate between planned, active management to sustain not only early-successional habitats but also the various benefits they currently receive, and random forest fragmentation from development and "bad management" that will diminish the benefits they currently experience.

The most effective communication messages about the benefit-to-cost ratio of using timber management to sustain early-successional habitats likely would be those that "…appear to

be strong arguments, not only to the managers themselves, but to the audience who is to receive that information" (Tarrant et al. 1995). While seemingly obvious, this approach probably would not be not simple to implement. One reason for this with respect to large geographic areas like the GNF is that even scientists disagree about the various effects (and when they might occur in a temporal scale) – partly because the disagreements become conflicts over both means and ends (e.g., McCool and Guthrie 2001). What are the most important ends (i.e., services and products)? Is sustaining early-successional habitat the best means for achieving those ends?

In an effort to reflect the various interests of the public in management decisions with the GNF, natural resource practitioners could benefit from being cognizant of definitions and meanings of different successional stages that may or may not be widely shared. What are the trade-offs, in terms of meanings sustained or lost, and what is the distribution of those trade-offs among the residents of the GNF?

A potential challenge described by Gray et al. (2001:3) was: "How can communities of place – rural and urban – both work together and work in ways that involve communities of interest? Fortunately, this challenge may not be all that great in the GNF. We found remarkable similarities in the beliefs and attitudes of rural and non-rural respondents.

Finally, both our anti-ecologistic and Yarrow's anti-scientistic orientations reinforce our other conclusions that messages about the ecological importance of different successional stages and the ecological importance of sustaining early stages may not resonate well with many GNF residents. Instead, the messages that are most likely to resonate are those highlighting a combination of utilitarian and amenity values. Residents of the GNF seem to hold dear the practical utility of the forest as well as its substantial aesthetic beauty. They know it is important ecologically and associate instrumental ecological meaning with it, even if their specific ecological knowledge is relatively low. Residents seem to appreciate the economic products from the forest, and associate cultural meaning especially with early-successional stages.

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Appendix A:

Study Questionnaire

How Does Forest Management Affect Residents of the Great Northern Forest?

A survey of your opinions

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About This Survey

This survey is being conducted by the Human Dimensions Research Unit in the Department of Natural Resources at Cornell University. The purpose of this survey is to determine public attitudes about management of the Great Northern Forest that stretches from northern New York, through Vermont and New Hampshire, to Maine. Local and state officials and conservation organizations need this information to make the best possible decisions about how to sustain those aspects of the Great Northern Forest that are most important to its residents.

Directions for filling out this questionnaire

We want to be sure to have a random sample of adults complete our survey. We would like the person in your household who has had the most recent birthday and who is at least 18 years old to complete the questionnaire. It should only take about 15 minutes. Your answers will be treated confidentially. This questionnaire has an identification number on the back so that we can check-off your household when you return the questionnaire – and we will not send you another one. Your name will never be associated with the information you provide.

Please complete this questionnaire at your earliest convenience. Then simply seal it, and drop it in the mail (return postage has been provided).

Thank You For Your Assistance!

Throughout this questionnaire, the term "Northern Forest" refers to the great swath of forested lands stretching from northern New York through Vermont, New Hampshire, and into Maine. The Northern Forest includes a combination of public lands (State Forest, National Forest) and private lands owned by timber companies, ski areas, hunting clubs, and private citizens.

YOUR RELATIONSHIP TO THE FOREST

1. Which of the following benefits do you get from the Northern Forest? (*Check all that apply*.)

___ Observing trees/flowers
___ Scenic enjoyment
___ Hunting deer or moose
___ Hunting grouse or rabbits
___ Selling Christmas Trees
___ Camping
___ Observing wildlife
___ Hiking or x-country skiing
___ Maple sugar products
___ Locally made furniture
___ Firewood for personal use
___ Income from firewood
___ Income from timber
___ Income from hunting lease
___ Horseback riding
___ Grazing or pastureland
___ Spiritual renewal/solitude
___ Personal residence
___ Investment property
___ Vacation property
___ I or close family member employed in wood products industry

The age of various parts of the Northern Forest varies widely. Some parts of the forest are relatively young (0-20 years old). These parts are called "early successional stages." Other parts contain many trees that are quite old (100+ years). These parts are called "late successional stages."

2. Would you say your general attitude toward parts of the Forest in <u>"early successional stages"</u> is positive, negative, or neutral? *(Circle one choice below.)*

Extremely negative	Moderately negative	Slightly negative	Neither positive nor negative	Slightly positive	Moderately positive	Extremely positive

3. Would you say your general attitude toward parts of the Forest in "late successional stages" is positive, negative, or neutral? *(Circle one choice below.)*

Extremely negative	Moderately negative	Slightly negative	Neither positive nor negative	Slightly positive	Moderately positive	Extremely positive

YOUR BELIEFS ABOUT THE NORTHERN FOREST

For each question below, circle one choice on the right that best reflects your beliefs about the Northern Forest.

4. In a natural state, the Northern Forest would be a mix of early successional stages, middle-age stages, and late stages — Yes / Not sure / No

5. Currently, more acreage of the Northern Forest is in early successional stages (0-20 years old) than there was in 1950 — Yes / Not sure / No

6. Some kinds of plants and animals live almost exclusively in early successional stages and cannot live in older stages — Yes / Not sure / No

7. The renewal of early successional stages through events like wildfire, ice storms, and logging decreases the overall variety of plants and animals found in the Forest — Yes / Not sure / No

8. Early successional stages are disappearing faster than they are being renewed in the Northern Forest — Yes / Not sure / No

9. The same kinds of plants and animals are found in late successional stages as are found in early successional stages — Yes / Not sure / No

10. Do you like or dislike the prospect of timber management being used to renew" early successional stages" in the Northern Forest? *(Circle one choice below.)*

Strongly dislike	Moderately dislike	Slightly dislike	Neither like nor dislike	Slightly like	Moderately like	Strongly like

WHAT IS IMPORTANT TO YOU ABOUT THE NORTHERN FOREST?

11. How much do you agree or disagree with each of the following statements? (*Circle one number for each statement*).

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I enjoy seeing unusual and attractive trees	1	2	3	4	5
I have little interest in knowing about the roles of young trees vs. old trees in the lives of forest animals	1	2	3	4	5
Plants like Sumac and Red Maple are of little value to nature	1	2	3	4	5
The best trees in the forest are ones that can be used for a purpose like lumber, paper, or furniture	1	2	3	4	5
If given the choice to see a colorful aspen or a drab oak, I would rather see the aspen	1	2	3	4	5

12. Is the idea of renewing early successional stages of the Northern Forest through timber management a good idea or a bad idea? *(Circle one choice below.)*

Extremely good	Moderately good	Slightly good	Neither good nor bad	Slightly bad	Moderately bad	Extremely bad

13. How much do you agree or disagree with each of the following statements? (*Circle one number for each statement*).

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Love and emotions should be felt for people, not trees or forests	1	2	3	4	5
Cutting trees for wood products is ok as long as the tree species is not endangered	1	2	3	4	5
I am attracted to the forest because I feel I am close to nature there	1	2	3	4	5
I have little desire to know about the ecology of the Northern Forest	1	2	3	4	5
My love for nature is one of my strongest feelings	1	2	3	4	5
My interest in forests is less about any one type of tree and more about how all the types interact	1	2	3	4	5
I like trees the most that have practical value	1	2	3	4	5

14. To what extent do you agree or disagree with the following statements about "early successional stages" of the Northern Forest?

Early-successional stages…	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
are beautiful to see	1	2	3	4	5
contain very few plants or animals	1	2	3	4	5
are a place for spiritual renewal	1	2	3	4	5
detract from leaf-viewing tourism	1	2	3	4	5
help define the cultural heritage of the area	1	2	3	4	5
are avoided by people who like to identify and watch birds	1	2	3	4	5
add to hunting tourism result from bad forest management	1	2	3	4	5
provide the necessary conditions for certain animals to survive	1	2	3	4	5
detract from the economic vitality of local communities	1	2	3	4	5
are a place for me to do activities that are an important part of who I am as a person	1	2	3	4	5
reflect how our cultural heritage is tied to careful use of the forest	1	2	3	4	5

15. How much do you agree or disagree with each of the following statements? (*Circle one number for each statement*).

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I enjoy seeing different types of trees in the forest but have little interest in knowing how various types affect water quality	1	2	3	4	5
I like forests because of the sense of solitude and peace I receive there	1	2	3	4	5
I see little wrong with logging the forest if that produces jobs for local residents	1	2	3	4	5
I have little desire to see unusual or rare types of trees in the forest	1	2	3	4	5
The idea of loving a forest strikes me as strange	1	2	3	4	5
Maintaining our standard of living through logging is more important than protecting a tree species from going extinct	1	2	3	4	5
Thorny trees and Poison Ivy should be eliminated from forest trails because they are a safety hazard	1	2	3	4	5

WORDS YOU ASSOCIATE WITH THE NORTHERN FOREST

16. In each row below, circle one number in the left column to reflect how you feel about "early successional stages" and circle one number in the right column that reflects how you feel about "late successional stages".

Early-successional stages							Late-successional stages						
happy	1	2	3	4	5	sad	happy	1	2	3	4	5	sad
scared	1	2	3	4	5	safe	scared	1	2	3	4	5	safe
calm	1	2	3	4	5	agitated	calm	1	2	3	4	5	agitated
useful	1	2	3	4	5	wasteful	useful	1	2	3	4	5	wasteful
interested	1	2	3	4	5	bored	interested	1	2	3	4	5	bored
disgusted	1	2	3	4	5	pleasant	disgusted	1	2	3	4	5	pleasant
good	1	2	3	4	5	bad	good	1	2	3	4	5	bad
clean	1	2	3	4	5	dirty	clean	1	2	3	4	5	dirty
valuable	1	2	3	4	5	worthless	valuable	1	2	3	4	5	worthless
empty	1	2	3	4	5	full	empty	1	2	3	4	5	full
sacred	1	2	3	4	5	mundane	sacred	1	2	3	4	5	mundane
relaxed	1	2	3	4	5	tense	relaxed	1	2	3	4	5	tense
nice	1	2	3	4	5	awful	nice	1	2	3	4	5	awful
bright	1	2	3	4	5	dark	bright	1	2	3	4	5	dark
healthy	1	2	3	4	5	sick	healthy	1	2	3	4	5	sick
fragrant	1	2	3	4	5	foul	fragrant	1	2	3	4	5	foul

17. Do you approve or disapprove of using timber management to renew early successional stages of the Northern Forest? *(Circle one response below.)*

Strongly approve	Moderately approve	Slightly approve	Neither approve nor disapprove	Slightly disapprove	Moderately disapprove	Strongly disapprove

18. How much do you agree or disagree with each of the following statements? (*Circle one number for each statement*).

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The needs of people are more important than the needs of trees and forests	1	2	3	4	5
When I am in the forest, I enjoy seeing taller trees rather than shorter trees and shrubs	1	2	3	4	5
Being surrounded by a forest makes me feel like a part of nature	1	2	3	4	5
I see little wrong with clear-cutting as a way of renewing forests	1	2	3	4	5
I am a person who really loves the forest	1	2	3	4	5
I try to avoid places in the forest where trees are dirty or have insects	1	2	3	4	5

INFORMATION ABOUT YOU

19. How much forest land do you own or lease?
(Check all that apply below, and fill in acreage.)

___ I do not own or lease any forest land
___ I lease about ____ acres
___ I own about ____ acres

20. Are you . . .? *(Circle one number.)* 1. Female 2. Male

21. In what year were you born? *(Fill in the blank.)* 19 ____.

22. How would you describe the type of area where you live?

_____ on a farm
_____ a rural area, but not a farm
_____ village or city with fewer than 25,000 people
_____ city with 25,000 to 49,999 people
_____ city with more than 50,000 people

23. What is the highest level of education you have attained? (*Check one line*.)

___ Primary school
___ High school or GED
___ Some college
___ College graduate (B.A., B.S.
___ Postgraduate degree (M.S., PhD)
___ Professional degree (MD JD)

THANK YOU VERY MUCH FOR YOUR ASSISTANCE

To return this questionnaire, simply seal it with the white reusable seal (postage has been provided) and drop it in the nearest mailbox.

Appendix B:

Assessment of Possible Response Bias

Variable	Un-weighted data			Weighted to account for differential response rates by substrata				Weighted to account for differences in numbers of male and female respondents			
	n	mean	SD	n	mean	SD	p-value	n	mean	SD	p-value
Attitude toward early-successional stages of the forest[a]	1079	5.34	1.428	1078	5.35	1.429	0.8709	1105	5.35	1.430	1.0000
Attitude toward late-successional stages of the forest[b]	1068	5.84	1.382	1094	5.84	1.388	1.0000	1069	5.86	1.375	0.7374
Attitude toward use of timber management to sustain early-successional stages of the forest[c]	1070	1.12	1.439	1095	1.12	1.443	0.9614	1067	1.07	1.451	0.4620
Ecological knowledge about successional stages and related plant and animal diversity in the forest [d]	1071	2.91	1.392	1097	2.91	1.388	0.9733	1070	2.88	1.399	0.5730

[a] Response to single, seven-point item, where 1 = extremely negative and 7 = extremely positive.

[b] Response to single, seven-point item, where 1 = extremely negative and 7 = extremely positive.

[c] Average of three, seven-point items, where -3 = very negative anchor point and +3 = very positive anchor point.

[d] Sum of six items, where 0 = incorrect response or "not sure" and 1 = correct response.